THE EBENEZER CREEK WATERSHED PROTECTION DEMONSTRATION PROJECT

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Abstract. In 1993 the Georgia Department of Natural Resources obtained funding from the U.S. Environmental Protection Agency to conduct a watershed-based study ot Ebenezer Creek, a blackwater stream which discharges into the Savannah River in Effingham County. The lower portion of the creek, designated a Georgia Scenic River and a National Natural Landmark, is a backwater swamp with an old growth baldcypress-water tupelo community. Over the past ten years this portion of the creek has shown signs of eutrophication, impacting water quality and recreational use. In an attempt to better understand the problems of the creek ecosystem and to find implementable solutions, representatives from various conservation groups and public agencies formed the Ebenezer Creek Technical Working Group (TWG). This group served in an advisory capacity during the course of the study. The overall goals of the watershed study were to determine the eutrophication status of Ebenezer Creek, identify significant nutrient sources, assess watershed management strategies, and obtain community input regarding the future management of this important natural resource area.

Studies were undertaken to assess the environmental status of the watershed in terms of biodiversity, land use changes, and water quality. The sampling results from this project were also intended to provide a baseline for future environmental monitoring. Based on study results and general knowledge of the area, the Technical Working Group generated six recommendations regarding future management of the watershed. The study results and management recommendations were presented at a public forum held in Effingham County in October, 1996. Local citizens reviewed and commented on the project findings, and recommended management strategies. The purpose of this paper is to present the background and process of the watershed protection demonstration project, to report the findings and management recommendations developed by the Technical Working Group, and to discuss the public's reactions and priorities regarding future management of the Ebenezer Creek watershed.

INTRODUCTION

In 1993 the Georgia Department of Natural Resources (DNR) obtained funding from the U.S. Environmental Protection Agency's Wetlands Protection Development Grant Program to conduct a watershed-based study of Ebenezer Creek, a blackwater stream that discharges into the Savannah River in Effingham county (Figure 1). The lower portion of Ebenezer Creek is characterized as a

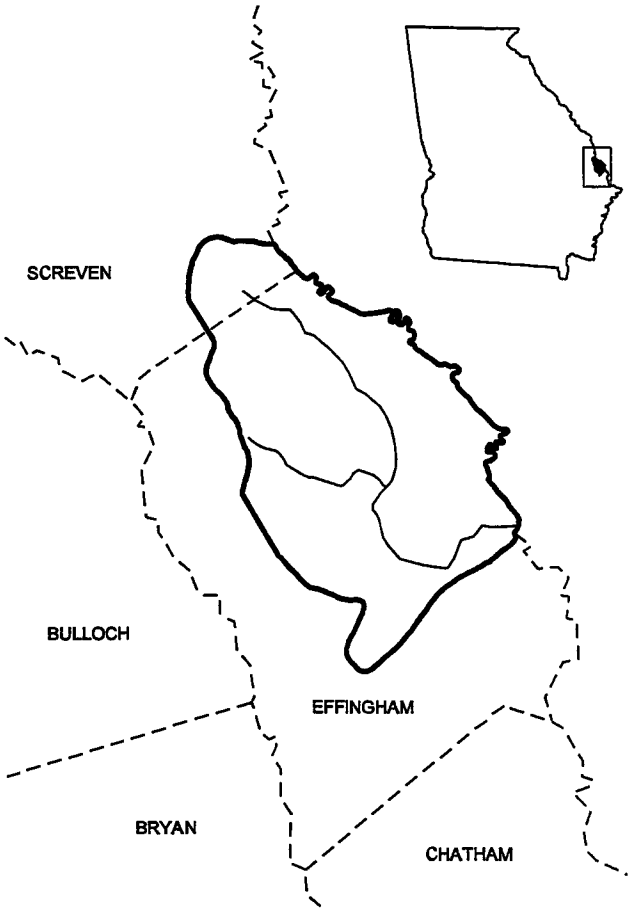

Figure 1. Location of Ebenezer Creek study area.

"backwater swamp" environment, in which water levels in the relatively flat creek basin are influenced greatly by the rise and fall of the Savannah River. This portion of the creek contains an old growth baldcypress-water tupelo swamp, and has been designated both a Georgia Scenic River and a National Natural Landmark.

Over the past ten years Ebenezer Creek has exhibited signs of increasing eutrophication. The swamp has experienced extremely low levels of dissolved oxygen, periodic fish kills, and thick growths of floating aquatic weeds. This eutrophication results in part from an abundance of nutrients, especially nitrogen and phosphorus. These nutrients enter the creek from point sources such as the City of Springfield's waste water treatment facility (WPCP), and nonpoint sources such as agricultural and urban runoff. Elevated nutrient levels in the stream promote aquatic plant growth. In addition, controlled water releases from dams on the Savannah River prevent the stream from drying up as it did in the past, and prevent aquatic plants from being flushed out of the creek. Thick mats of floating plants periodically block the creek channel, preventing oxygen from being absorbed into the water or being produced by underwater photosynthesis. As these plants die and decay, the oxygen demand associated with the decomposition process further depletes dissolved oxygen levels in the creek. During periods of critically low dissolved oxygen some fish kills have occurred. The goals of the watershed protection demonstration project were: 1) to determine the eutrophication status of Ebenezer Creek; 2) to identify, if possible, all significant inputs of nutrients to the creek; 3) to evaluate possible restoration alternatives; and 4) to assess watershed management strategies to protect this important natural resource.

Work on this project began in August of 1993. The major work elements of the project consisted of: 1) conducting a biodiversity assessment of lower Ebenezer Creek and its associated habitats; 2) developing a digital database of landcover, hydrology, geology, soils, elevation, and rare species locations for the watershed; 3) analyzing recent land use trends in the watershed; and 4) conducting physical and chemical sampling of sediments in the lower portion of the creek. The Georgia Department of Natural Resources' Wildlife Resources Division coordinated the project, with assistance from DNR's Environmental Protection Division (EPD), The University of Georgia's Institute of Community and Area Development (ICAD), and members of The Georgia Conservancy and Scenic Ebenezer, Inc. Representatives of these organizations, together with members of The Conservation Fund, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and governments of the City of Springfield and Effingham County comprised an ad hoc advisory committee known as the Ebenezer Creek Technical Working Group (TWG). The various studies were completed in the spring of 1996, and the results are summarized below. During the summer of 1996, the Ebenezer Creek TWG reviewed the study results and developed six recommendations for future management of the Ebenezer Creek watershed. A public forum was held at the New Ebenezer Retreat in Effingham County on October 29, 1996. At that time local citizens were invited to review and comment on the study results and recommendations and to help develop priorities for future management of the Ebenezer Creek watershed.

STUDY GOALS AND CONCLUSIONS

Biodiversity Assessment

The purpose of the biodiversity study was to investigate and document significant ecological resources present in the Ebenezer Creek watershed. Researchers sampled natural habitats in the watershed, concentrating on the creek and associated habitats in the lower portion of the watershed. Species lists or inventories were developed for birds, mammals, reptiles, amphibians, fish, aquatic macroinvertebrates, and rare vascular plants.

The watershed was found to contain several significant natural communities; these included examples of mesic bluff forest, blackwater creek swamp, wet pine flatwoods, coastal plain shrub bog, and bottomland hardwood forest. These communities are significant due to their intact nature, high species diversity, and relative scarcity in the region. Several rare plants and animals were also documented from the study area, further demonstrating the ecological significance of this watershed.

In general, the composition and diversity of fish and aquatic macroinvertebrate communities are influenced by physical and chemical habitat variables. A greater number of fish species was found in the upper creek (28) than in the swamp (19). This higher species richness in the upper portion of the watershed is attributable to greater variability in stream flow, available cover, and substrate size. Upstream portions of the creek also exhibit excellent habitat for macroinvertebrates. Habitat quality and species richness decrease gradually downstream as the channel widens, the stream bottom changes from gravel to mud and sand, pH decreases, and the quantity of woody debris and aquatic macrophytes increases. There was no evidence of a sharp discontinuity in the condition of macroinvertebrate or fish communities above or below the Springfield waste water treatment facility.

Field studies indicated that many natural communities and populations of rare species in the Ebenezer Creek watershed are being impacted by residential and industrial development, as well as timber harvest and forest conversion. Continuing development in the watershed is likely to result in a loss of natural biotic diversity and exacerbation of existing water quality problems in the lower portion of the creek.

Land Use Trends

The purpose of this study was to analyze changes in land use in the watershed over the period from 1958 to 1993 to determine trends which may have contributed to non-point source pollution in Ebenezer Creek. Findings indicate that in 1958, the watershed was largely forested (76%), with small to medium sized patches of crop-pasture (17%) and harvested-new growth lands (5%) scattered throughout the area. Relatively small residential-urban concentrations occurred at Clyo, Egypt, and Springfield (1.3% of the watershed).

Between 1958 and 1993, the greatest land use change in the watershed was the loss of about 11% of forested lands. Most of the forest losses were to harvested-new growth, residential, and urban uses. Although these land use changes were not dramatic, the concentration of residential and urban uses in the southern portion of the watershed (particularly within 1000 feet of the creek from Springfield downstream to the Savannah River) represents an important trend which may impact water quality. Other changes occurring within the corridor which may impact water quality are transitions from forest to harvested sites and agricultural uses. Continued transitions from forest to other uses, especially within the creek corridor, may compound existing water quality problems.

Water Quality Studies

Six water sampling stations were established along Ebenezer Creek between the city of Springfield and the Savannah River. Three of the stations were located upstream of the Springfield waste water treatment plant, and three were downstream of the facility. Water samples were collected twice a month and analyzed by EPD for inorganic nutrients (total phosphorus, orthophosphorus, nitrate-nitrite, total Kjeldahl nitrogen, and ammonia). Dissolved oxygen, temperature, and conductivity were also measured at the sampling stations. The water sampling program began in May 1994 and was continued for a full year. Objectives of this study were: 1) to determine whether there was a change in nutrient concentrations in the creek from upstream of the waste water treatment plant to the Savannah River; 2) to determine if there were any discrete sources of nutrient input other than the Springfield WPCP; and 3) to evaluate the feasibility of modeling the effects of phosphorus input on plant growth in the stream.

Analysis of the water samples revealed little variation in overall nutrient concentrations, and no consistent increase or decrease from upstream to downstream. The highest phosphorus concentration recorded occurred at the sampling site located furthest upstream. Sampling did not indicate any point sources of phosphorus other than the Springfield WPCP. Hydrologists from the U.S. Army Corps of Engineers' Waterways Experiment Station evaluated the sampling data and inspected Ebenezer Creek. They concluded that a nutrient/hydrologic model was unlikely to be useful in predicting the effect of elimination of phosphorus from the Springfield WPCP on aquatic plant growth.

Another goal of this portion of the watershed study was to determine the extent, nutrient concentration, and oxygen demand of muck deposits on the creek bottom. Two sediment sampling trials were conducted from the mouth of the creek upstream to Long Bridge (approximately 7 stream miles). These efforts failed to locate any significant organic deposits in the creek channel; instead, the substrate consisted of sand and silt, with some woody organic debris. Since there were no significant organic bottom sediments, an investigation of *in-situ* sediment oxygen demand could not be conducted.

MANAGEMENT RECOMMENDATIONS

After review and discussion of the study results, the Ebenezer Creek Technical Working Group developed six recommendations regarding future management of the watershed. The recommendations varied considerably in terms of the time, resources, planning, and political will necessary for implementation. The TWG did not attempt to prioritize the six recommendations, which are as follows:

1) Control aquatic vegetation as required. Target specific aquatic nuisance species early in their life cycles and employ a combination of chemical, biological, and mechanical control techniques (including physical harvesting of plants) to maintain an open creek channel and eliminate additional nutrient buildup in the system.

2) Allow natural flushing of Ebenezer Creek. Request that the U.S. Army Corps of Engineers work with the Georgia Department of Natural Resources to develop a controlled

release program on the Savannah River that would allow more natural flushing of Ebenezer Creek.

3) Eliminate waste water discharge into Ebenezer Creek. Avoid input of additional nutrients into Ebenezer Creek by implementing a land application program for treated waste water from the Springfield WPCP. In addition, assess the adequacy of existing residential septic systems adjacent to the creek.

4) Implement land use controls within a buffer zone along Ebenezer Creek. Issues for the county and city to consider include establishing standards or guidelines for agricultural, forestry, residential, commercial, and industrial uses. These guidelines could address minimum setbacks, protection of existing streamside vegetation, mitigation for impervious surfaces, and water use and sewage treatment.

5) Develop a greenway along Ebenezer Creek. Encourage private development of a greenway corridor to conserve and/or restore a buffer zone along Ebenezer Creek (particularly targeting the stream corridor from Springfield to the Savannah River).

6) Develop a watershed management strategy for the Ebenezer Creek watershed. Consider development of a specific watershed management strategy for this unique area, taking into account the entire suite of biotic resources found in the Ebenezer Creek watershed. Important elements of this strategy would be minimizing point and non-point source nutrient inputs to the creek, working with property owners to encourage protection of significant natural communities and rare species populations, and continuing monitoring of water quality, land use changes, and terrestrial and aquatic wildlife in the watershed.

PUBLIC FORUM COMMENTS

Large format poster displays of the study results and watershed management recommendations were made available for public review at the Effingham Regional Library in Springfield for a week prior to the public meeting. The meeting, held on October 29, 1996 at the New Ebenezer Retreat and Conference Center in Effingham County, consisted of two parts: a day long drop-in session and a facilitated evening community forum. Four people attended the drop-in session; twenty-five people attended the evening meeting.

The drop-in session was arranged to provide interested citizens an opportunity to examine the study results and recommendations in detail and to speak personally with the researchers and other TWG members. TWG representation at the sessions included: the Georgia Department of Natural Resources (Wildlife Resources and Environmental Protection Divisions), the Institute of Community and Area Development, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the City of Springfield, The Georgia Conservancy, Scenic Ebenezer, Inc., and The Conservation Fund. Representatives of the Chatham County Adopt-A-Stream Program also presented an informational display at the meeting. Unfortunately, the drop-in session was not mentioned in the meeting announcement published in the local newspaper and the session was not well attended. However, the displays were left in place and the first half hour of the evening meeting was treated as a drop-in session.

The purpose of the evening meeting was to present an overview of the project's objectives, methods, and conclusions, and to provide a forum for local residents and other interested parties to ask questions, express concerns, and comment on the watershed management recommendations. TWG members and local elected officials were present to respond to questions. Meeting participants were encouraged to seek clarification of the study results and recommendations, and to raise issues which they felt should be addressed by the group.

Early in the evening session participants were polled regarding the impact and cost of implementing each of the six recommendations. A computerized system utilizing Resolver software and remote keypads registered each response, maintaining the anonymity of the participants. The Resolver software system was employed to rapidly tally and display the results of each poll, and to show major areas of consensus and disagreement.

Each participant was asked to indicate what the impact of implementing a particular managment recommendation would be on Ebenezer Creek, and what they felt the cost of implementing a recommendation would be. Two important clarifications were made during the polling exercise. First, in the context of this meeting, "cost" was intended to represent the various demands associated with any community undertaking, including economic and social costs. Secondly, a determination of "high cost" did not mean that a recommendation should not be implemented.

In general, poll results indicated that the group thought four of the six recommendations would provide high positive impact at low cost. These recommedations were: 1) develop a watershed management strategy; 2) develop a greenway along Ebenezer Creek; 3) implement land use controls in a buffer zone around the creek; and 4) allow

natural flushing of the creek and swamp system. Poll results indicated that the recommendation to eliminate waste water discharge into the creek would provide significant benefits at a higher cost, and the recommendation to control aquatic vegetation was perceived to provide relatively insignificant benefits to the Ebenezer Creek watershed at a low to moderate cost.

In addition to the computer-assisted polling exercise, participants were asked to provide written comments regarding each of the recommendations. The participants' oral and written comments were important in interpreting the polling results and public response to the management recommendations. Based on these comments, development of a watershed management strategy and greenway were seen as helping to improve the health of Ebenezer Creek, but not "curing" the creek's problems. These recommendations were seen as having additional benefits of preserving old growth forest and enhancing public education and awareness of environmental issues.

The group's response to implementation of land use controls was mixed, which might be expected since many of the participants own property and/or live along the creek. One comment suggested that land use controls are crucial, especially as the county grows in the future. Other comments indicated an opinion that there is not a problem with land use, and that nothing should be done. General concerns were expressed regarding grandfathering existing uses and enforcement of land use controls.

From the beginning of this project, a major focus of some local residents has been to eliminate waste water discharge from the Springfield WPCP into Ebenezer Creek. Meeting comments indicated that elimination of discharges into the creek should be a high priority; however, this goal was not seen by many as immediately obtainable. For the last three years the Springfield WPCP has utilized a land application system to reduce its total yearly discharge to the creek. However, additional land and equipment are needed to establish a permanent land application system that would obviate the need for any further discharges to Ebenezer Creek.

A considerable amount of the general discussion at the meeting revolved around this emotionally-charged issue. In particular, some local residents complained that the Springfield waste water treatment plant never should have been permitted, given the documented sensitivity and ecological significance of Ebenezer Creek. Furthermore, some attendees of the public forum apparently regard the elimination of waste water discharges into the creek as the primary solution for restoration of environmental quality in the Ebenezer Creek watershed.

Responses to the recommendation to allow more natural flushing of Ebenezer Creek suggested that the proposal was not well understood by the group. Comments indicated that individuals/governments should not further tamper with natural processes. It is possible that some streamside landowners were fearful of the consequences of flooding to their property and to recreational opportunities. A more detailed explanation of the proposed quantity, frequency, and seasonality of flows might have resulted in better understanding and acceptance of this management recommendation.

The recommendation to control aquatic vegetation received several comments. Several participants felt that the recommendation should have been worded such that each proposed weed control method could be evaluated separately. In particular, some of the respondents objected to any use of herbicides; however, they approved of physical harvesting to keep the creek channel open. Given the strong reservations expressed by some participants, polling results on the overall effectiveness of this recommendation are somewhat difficult to interpret. In general, however, participants felt that control of aquatic vegetation would not eliminate the problem of nutrient loading in the creek system.

CONCLUSIONS

The Ebenezer Creek Watershed Demonstration Protection Project was conceived, supervised, and supported by the Technical Working Group, an informal committee of individuals with diverse backgrounds and interests. The multidisciplinary approach taken in this study was useful in framing the project goals, discussing and dealing with related environmental issues in the watershed, and perhaps most importantly, involving various stakeholders and agencies in the development of long-term and broad-scale resource management strategies. The public forum experience showed that a general consensus on certain management needs can be developed even where there is great controversy and emotional involvement; however, the consensus-building process depends heavily on an adequate natural resource data base, a certain level of trust and cooperation, and a basic understanding of the environmental threats and ecological processes being discussed.

The Ebenezer Creek Watershed Protection Demonstration Project concluded with the public forum. However, efforts to improve water quality in the watershed are ongoing. Representatives of the Georgia DNR are in consultation with the U.S. Army Corps of Engineers to assess the feasibility of modifying releases of water from

upstream dams on the Savannah River to provide more natural hydrologic conditions in the lower portion of Ebenezer Creek. . The City of Springfield is currently looking for additional land to support a full-time land application system for waste water. Efforts to develop a greenway based on voluntary management agreements with landowners along the lower portion of the creek are underway. Information derived from this study concerning land use patterns, vegetation types, rare species, significant natural communities, and water quality will be provided to local governments to aid in the planning process. It is hoped that the water quality and biodiversity monitoring efforts will be continued, and that support for local land use controls and a comprehensive planning process will be such that the significant ecological and recreational resources of the Ebenezer Creek watershed can be protected in the midst of economic development.

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